



Digital Twins as Remote Operations Centers (ROCs) for Alternative Energy



Pieter Van Schalkwyk - CEO

VISIT...

LANZAROTE
Caliente.COM

Alternative Energy Fun Facts for 2025

Investment in renewable generation by entities outside of the utility sector will surpass investment in renewable generation by utilities.

20% of energy utilities globally will manage periods of negative wholesale energy prices due to oversupply from renewable energy resources.

40% of utility field asset inspections will be performed by autonomous robotic systems automatically updating asset and maintenance conditions.

30% of G20 countries will drive flexibility markets with common process and data exchanges, in response to energy shortages.

2025 is closer than you think



40% of utility field asset inspections will be performed by autonomous robotic systems automatically updating asset and maintenance conditions.



Data available in real time at a Remote Operations Center (5G)

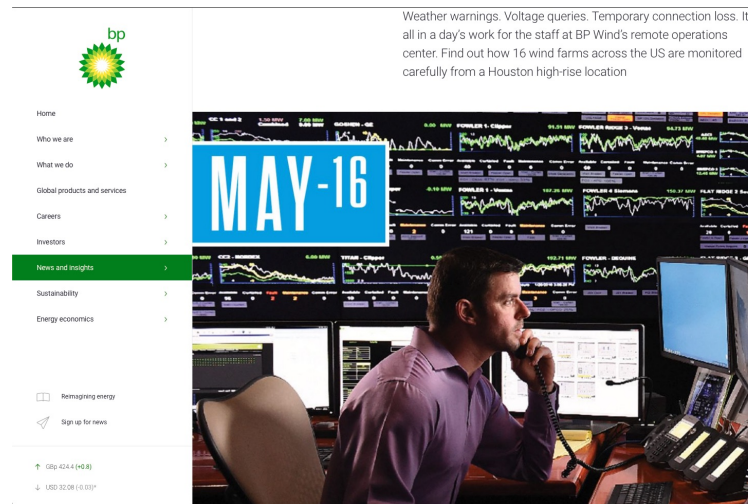
AE Remote Operations Centers: The Power Users

Renewable Control Center

Renewable Control Center

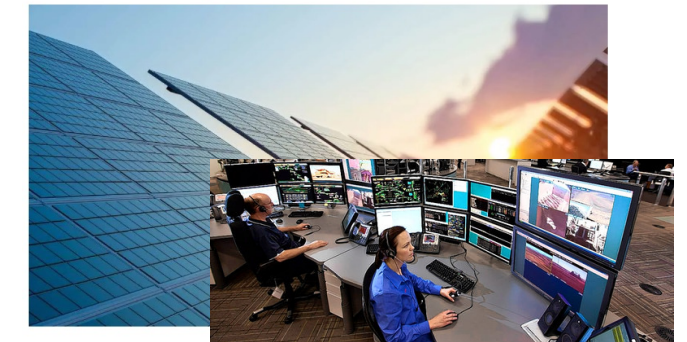


Duke Energy's Renewable Control Center (RCC) in Charlotte, North Carolina, uses powerful and secure technology to monitor wind and solar power plants across the country. Duke Energy entered the wind power business in 2007 and launched its commercial solar power business in 2009. The RCC provides critical monitoring services for all of Duke Energy Renewables' operating assets, which total about 3,000 megawatts (MW).



Rio Tinto powers ahead on solar farm to supply Pilbara iron ore mine

Sophie Vorrath 30 July 2021 0



Rio Tinto's first fully-owned solar farm is to begin construction within a few week after the engineering, procurement and construction partner for the project was announced this week.

ASX-listed company NRW Holdings revealed on Friday that it had won the roughly \$60 million contract for the delivery the 34MW Gudai Darri (Koodaideri) solar farm, with construction and commissioning scheduled for completion in early 2022.

Rio Tinto announced early last year that it would build a large-scale solar farm at its \$2.6 billion Gudai Darri iron-ore mine in Western Australia's Pilbara region, to supply all of its daytime electricity needs and two-thirds of its annual requirements.

Traditional Energy companies
with ROC control room

Oil & Gas companies investing in
Alternative Energy with ROCs

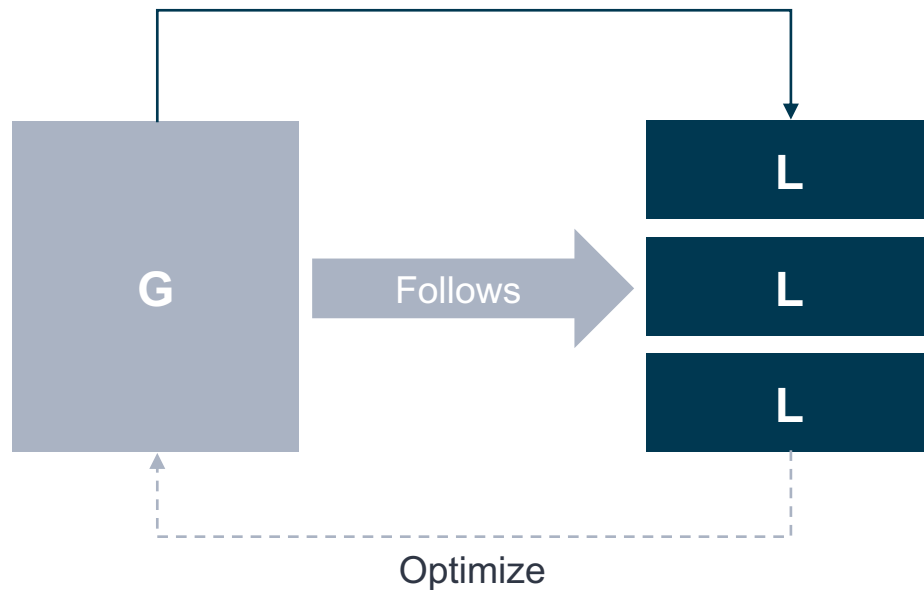
Industrial "Prosumers" like
infrastructure owners with DOCs

There is a Shift in Power . . .

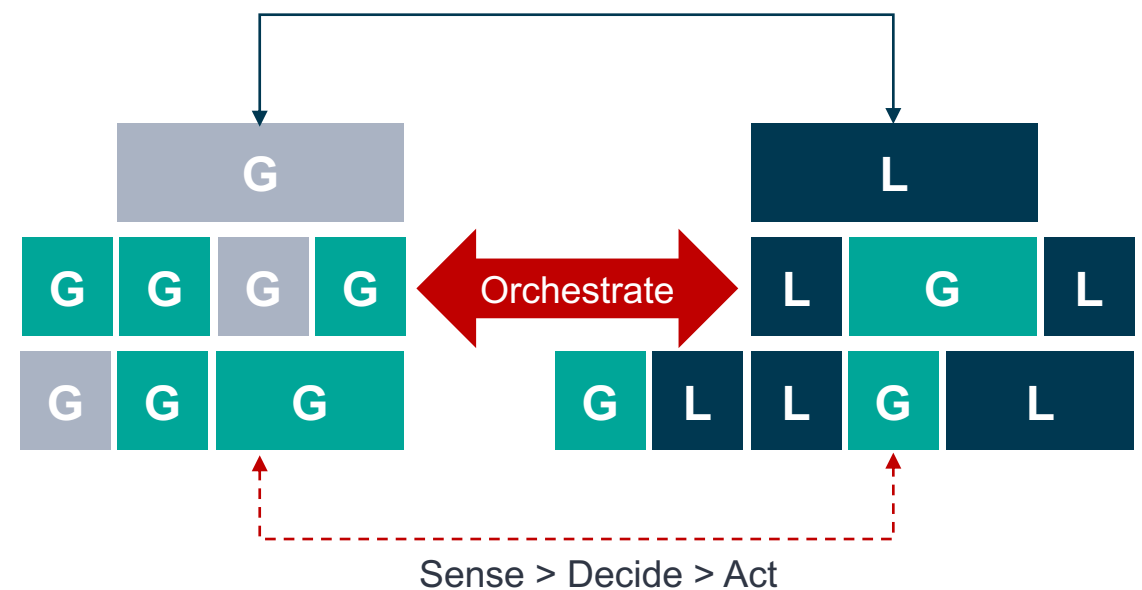
Yesterday

Today/Tomorrow

Predictable Load Matched With Dispatchable Supply
Reliability, Controllability, and Predictability



Loads Respond to Supply Intermittency
Collaboration, Orchestration, and Flexibility

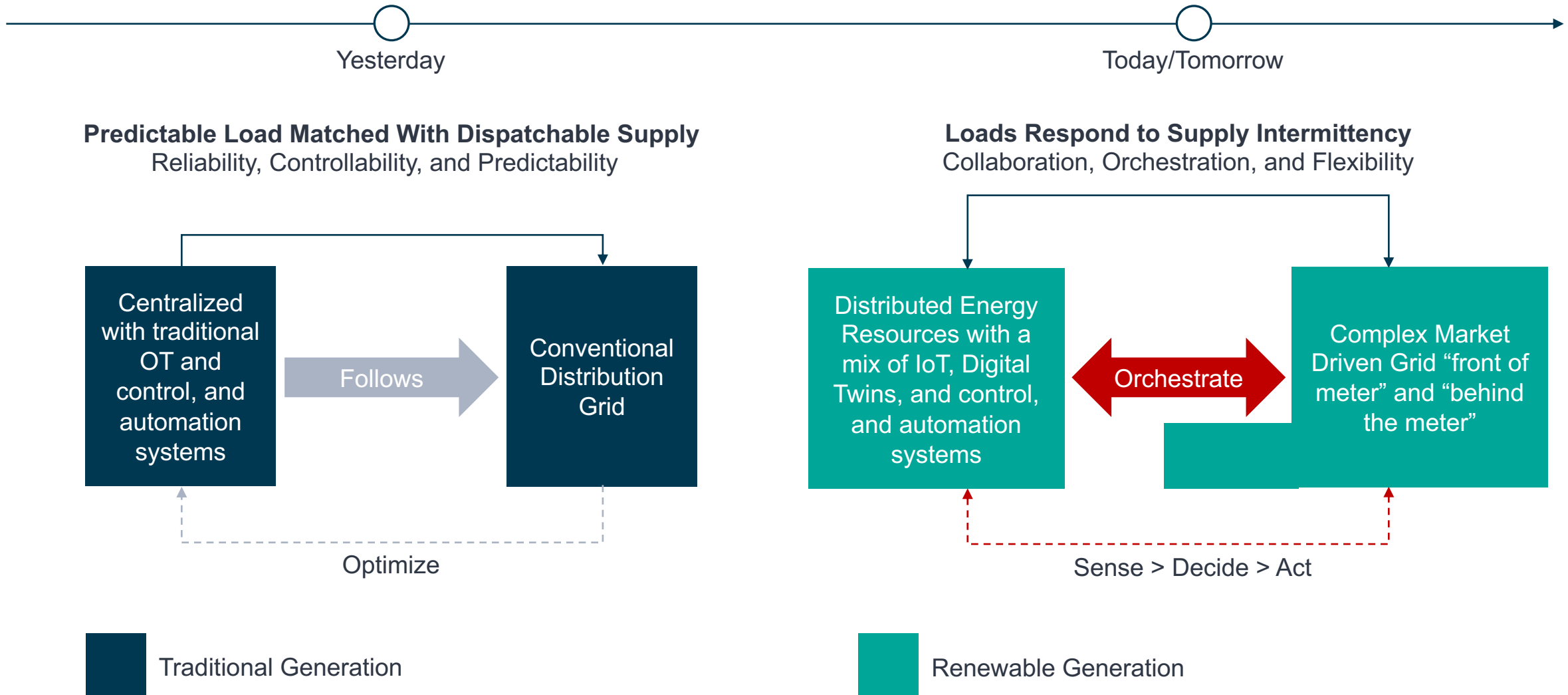


L Load

G Fossil/Nuclear-Fueled Generation

G Wind/Solar/Hydro Renewable Generation

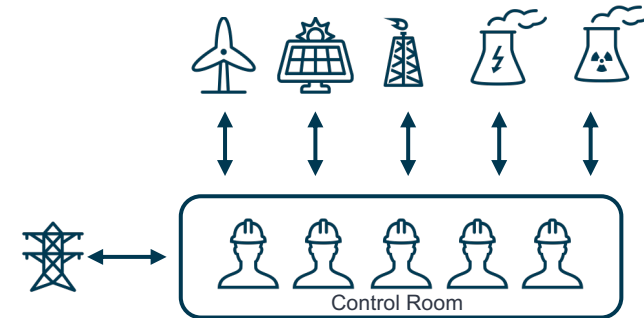
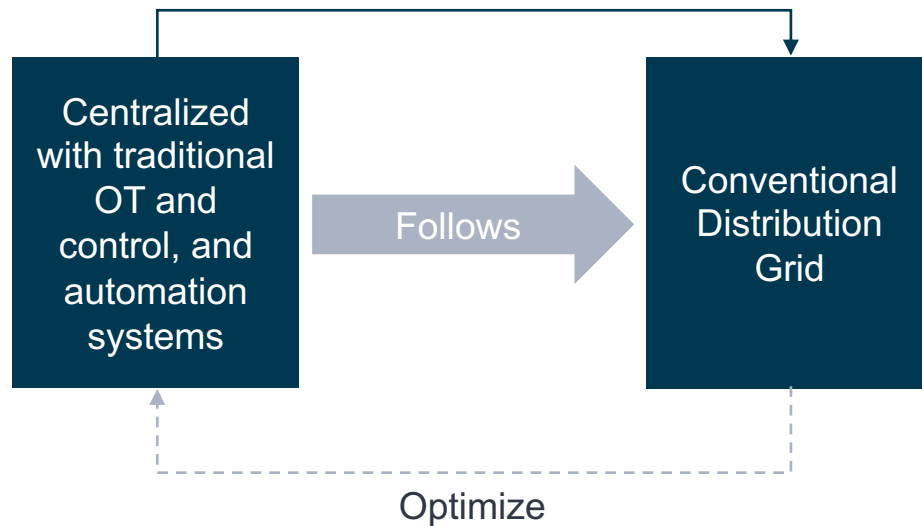
There is a Shift in Power . . .



There is a Shift in Power . . .

Yesterday

Predictable Load Matched With Dispatchable Supply
Reliability, Controllability, and Predictability

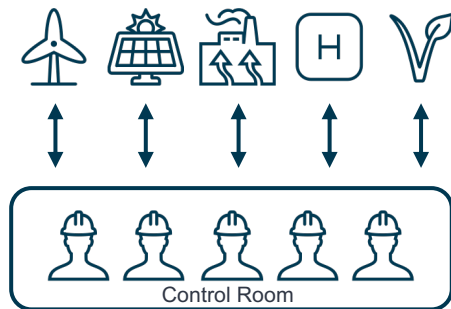


Operational Control Focused

Traditional Generation

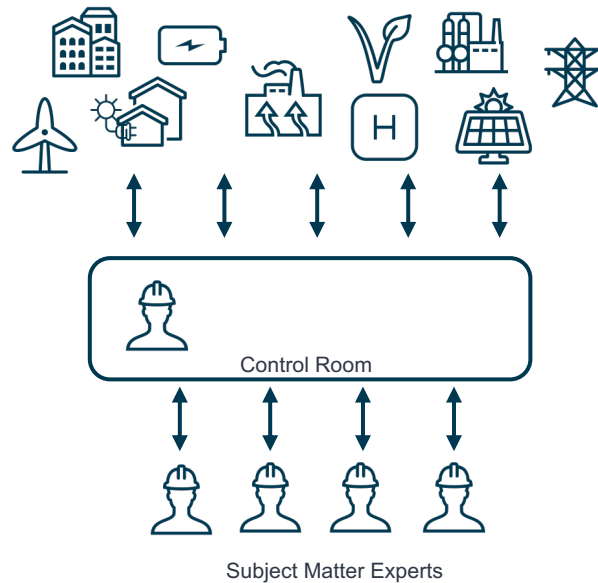
From ROC to DOC : Digital Twins for Value Chain

Traditional Command & Control Remote Operations Center



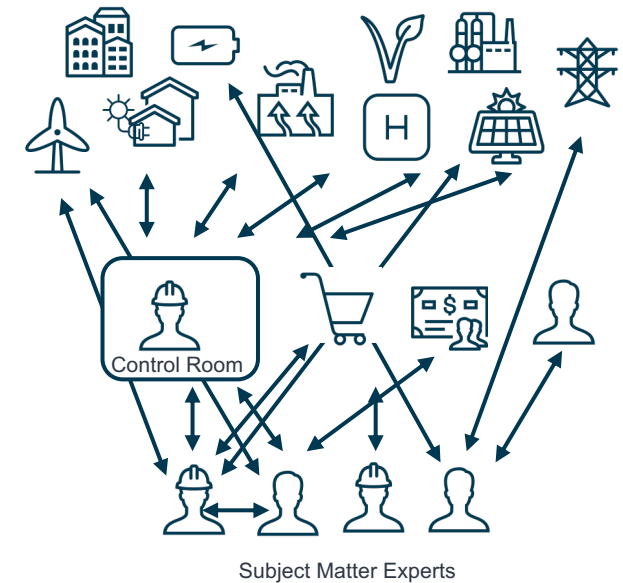
Operational Control Focused

Digital Twin Enabled Remote Operations Center



Operational Optimization Focused

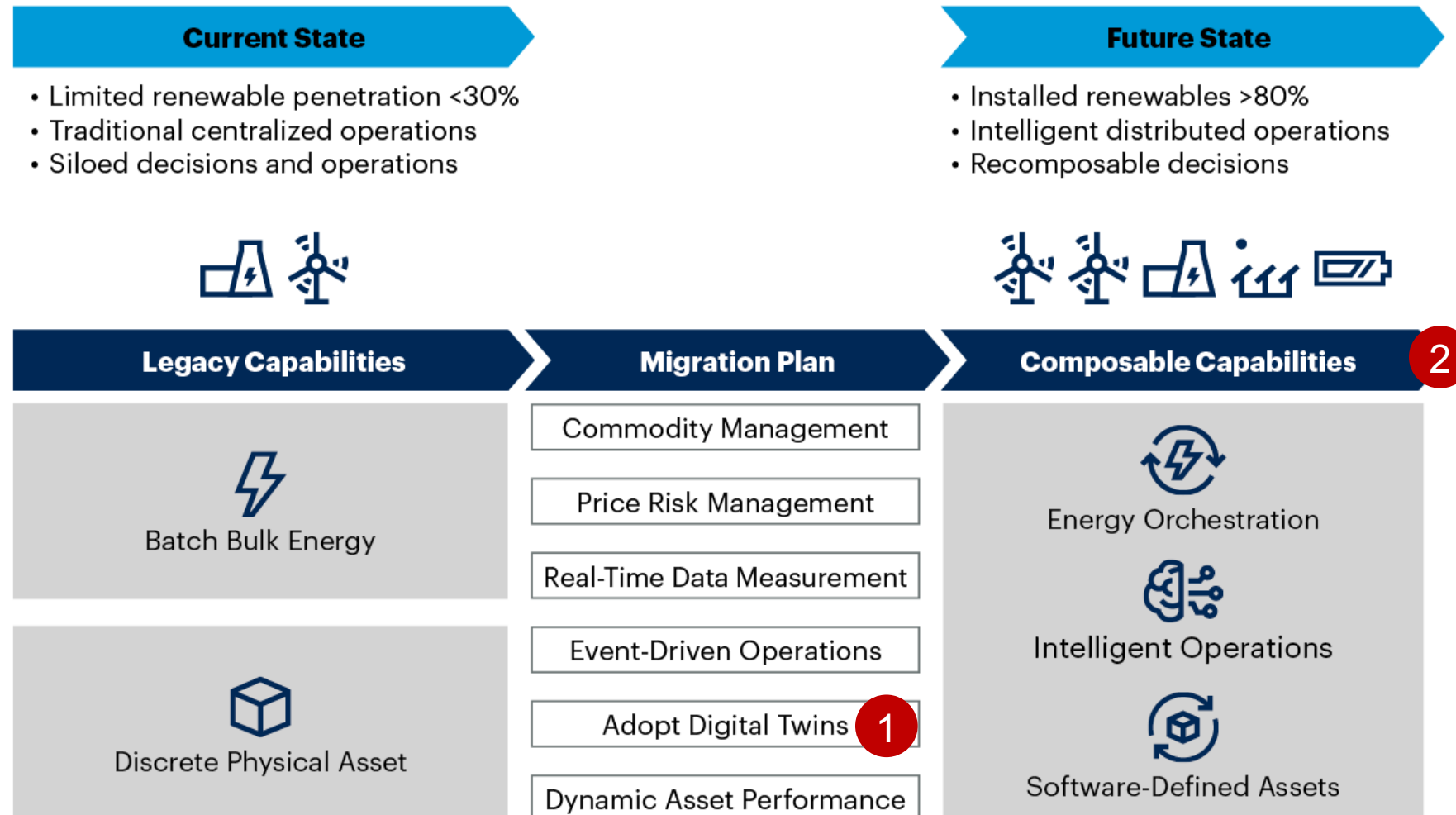
Digital Twin Enabled Distributed Operations Center



Value Chain Optimization Focused

This level summary and doesn't reflect all capabilities of ROC

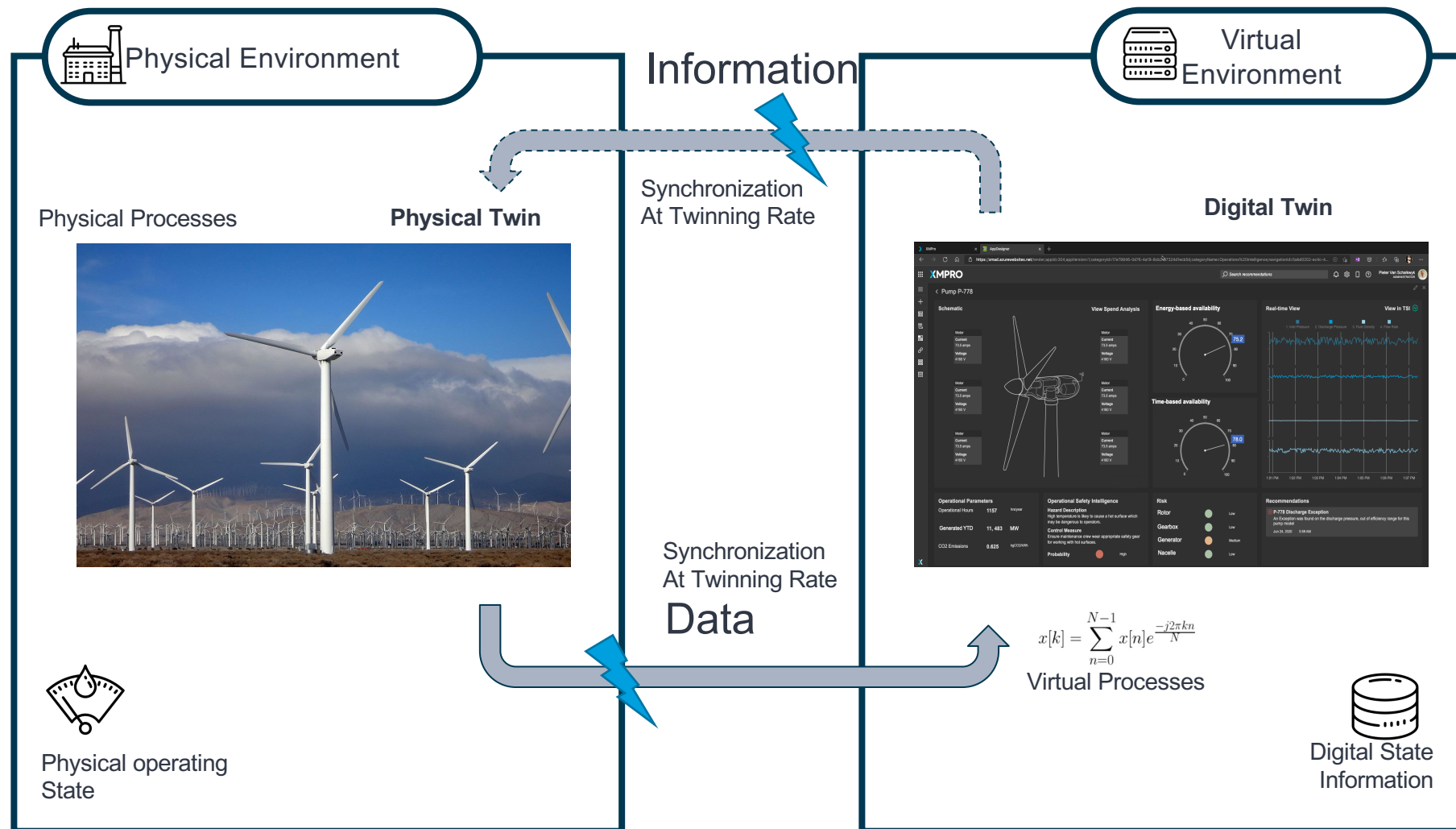
Deploy and Integrate Renewable Resources at Scale



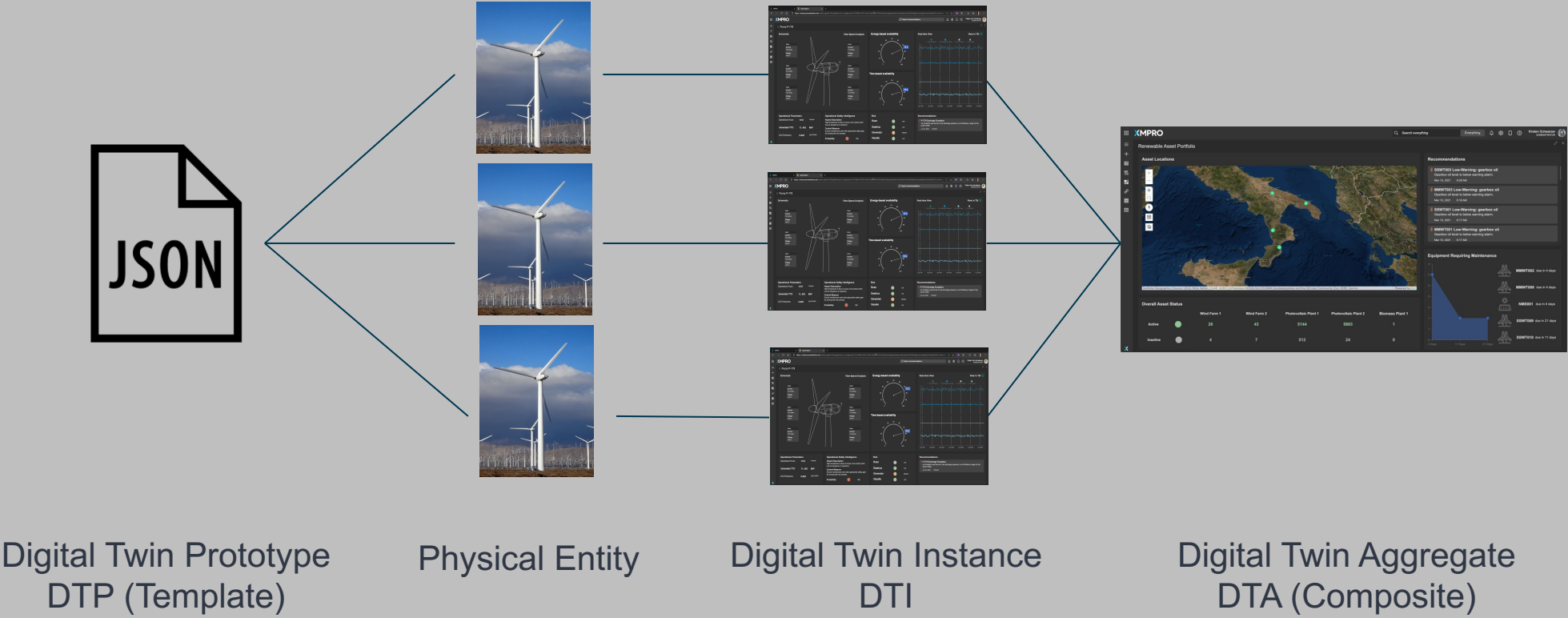
Source: Gartner

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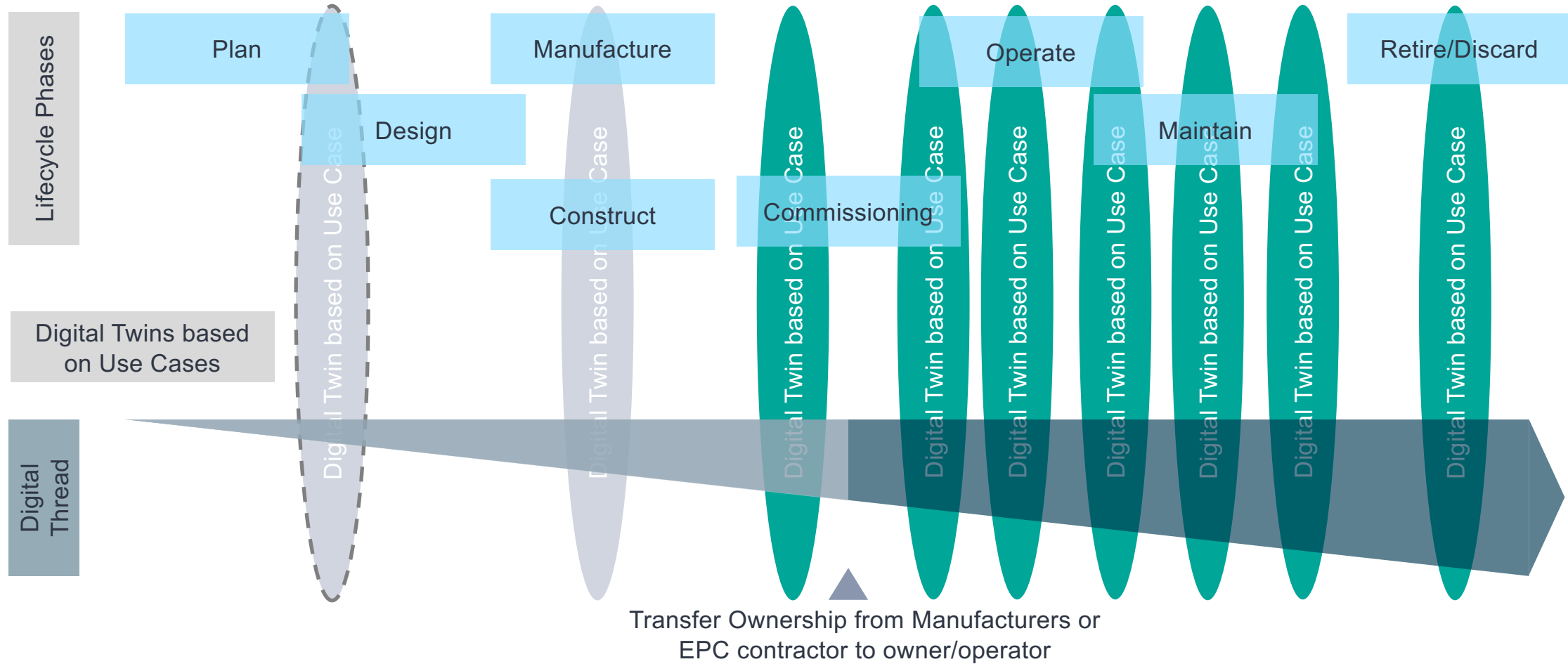
Digital Twins is a Model-based Approach



DTP vs DTI vs DTA for Renewable Energy



Digital Twin in ROC should focus on Capabilities



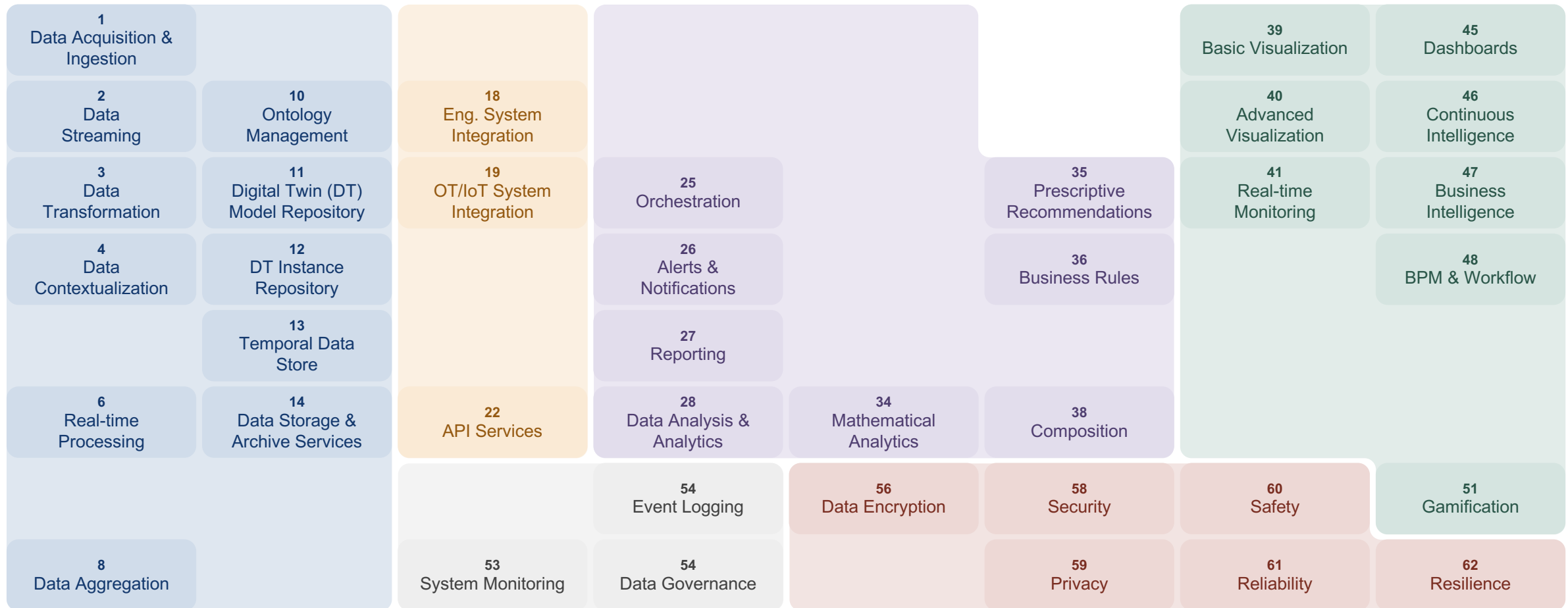
Digital Twin Capabilities Periodic Table

1 Data Acquisition & Ingestion	9 Synthetic Data Generation	17 Enterprise System Integration	23 Edge AI & Intelligence	29 Prediction		39 Basic Visualization	45 Dashboards
2 Data Streaming	10 Ontology Management	18 Eng. System Integration	24 Command & Control	30 Machine Learning ML		40 Advanced Visualization	46 Continuous Intelligence
3 Data Transformation	11 Digital Twin (DT) Model Repository	19 OT/IoT System Integration	25 Orchestration	31 Artificial Intelligence AI	35 Prescriptive Recommendations	41 Real-time Monitoring	47 Business Intelligence
4 Data Contextualization	12 DT Instance Repository	20 Digital Twin Integration	26 Alerts & Notifications	32 Federated Learning	36 Business Rules	42 Entity Relationship Visualization	48 BPM & Workflow
5 Batch Processing	13 Temporal Data Store	21 Collab Platform Integration	27 Reporting	33 Simulation	37 Distributed Ledger & Smart Contracts	43 Augmented Reality AR	49 Gaming Engine Visualization
6 Real-time Processing	14 Data Storage & Archive Services	22 API Services	28 Data Analysis & Analytics	34 Mathematical Analytics	38 Composition	44 Virtual Reality VR	50 3D Rendering
7 Data PubSub Push	15 Simulation Model Repository	52 Device Management	54 Event Logging	56 Data Encryption	58 Security	60 Safety	51 Gamification
8 Data Aggregation	16 AI Model Repository	53 System Monitoring	54 Data Governance	57 Device Security	59 Privacy	61 Reliability	62 Resilience

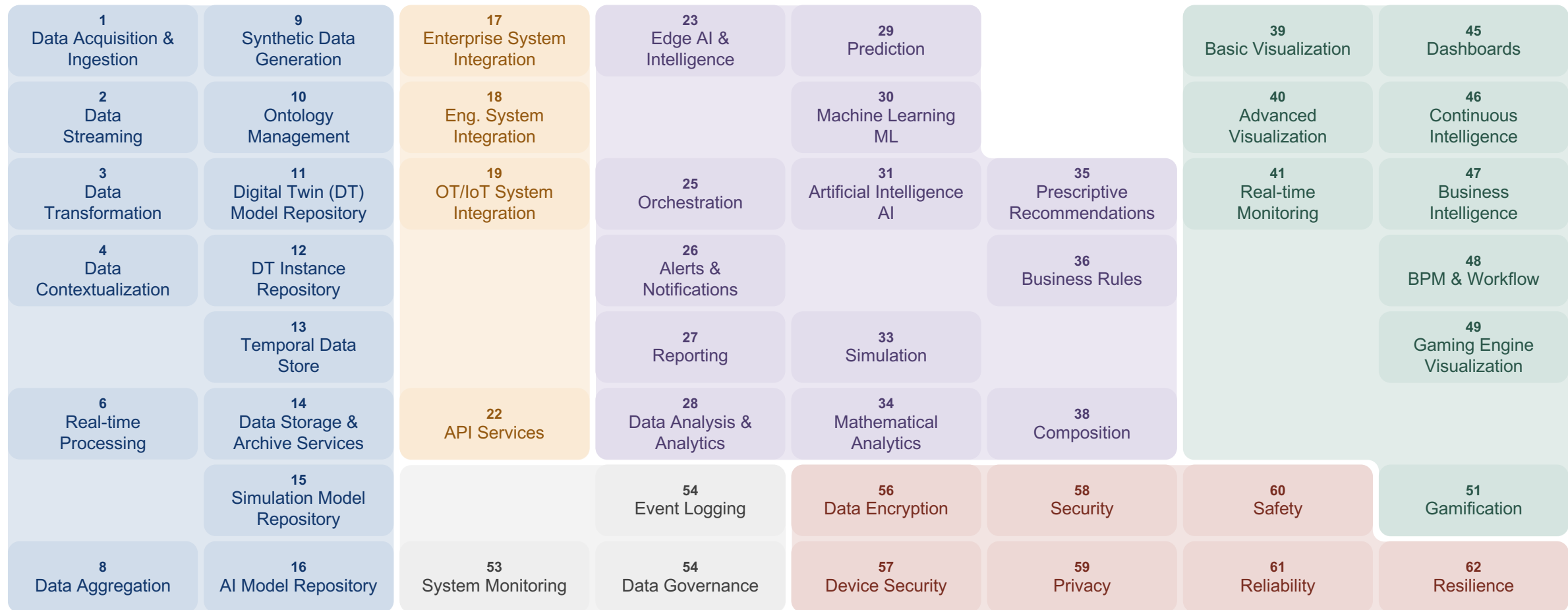
○ Data Services
○ Integration
○ Intelligence
○ UX
○ Management
○ Trustworthiness

<https://www.digitaltwinconsortium.org/initiatives/capabilities-periodic-table.htm>

Windfarm Condition Monitoring Use Case

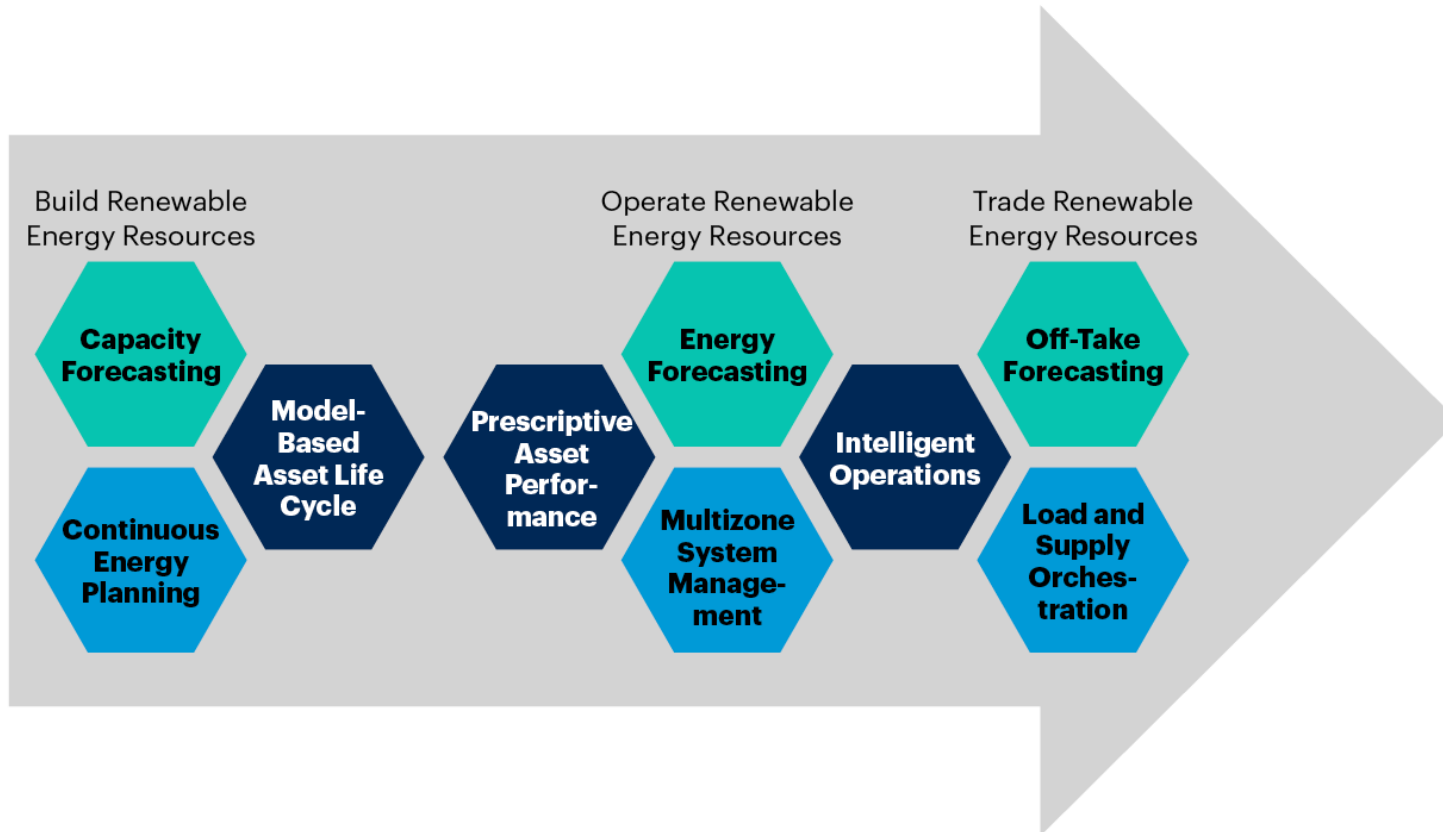


Windfarm Energy Prediction Use Case



Key Composable Business Capabilities for RE

◆ Asset Capability ◆ Commodity Capability ◆ Forecast Capability

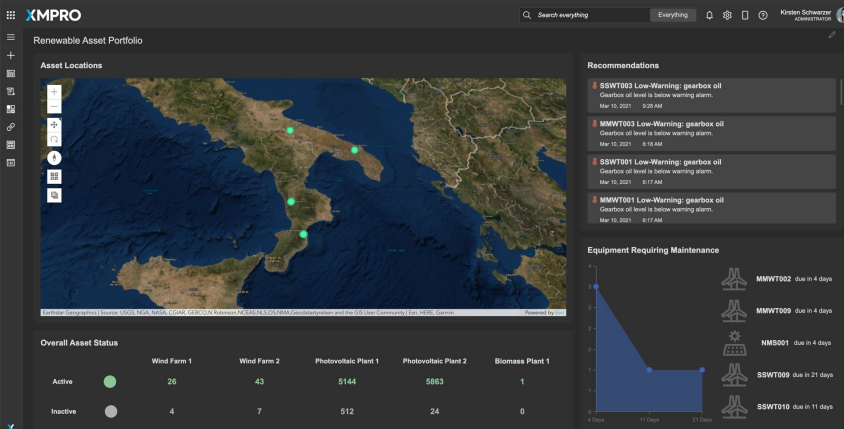


Composable Digital Twins as the basis for Distributed Operations Centers for Renewable Energy

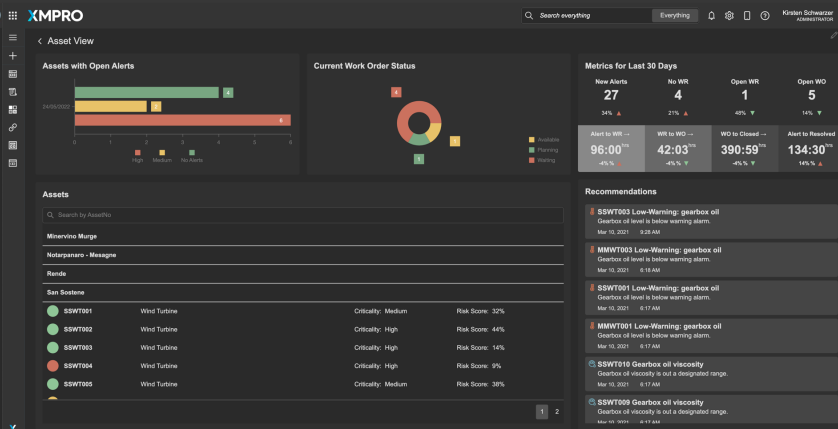
Scenario: Retail group with DERs on properties

Infrastructure owners like retail or property groups are deploying Alternative Energy across assets to reduce cost and carbon. They use AI-enabled Digital Twins to decide when to generate, store, use, or trade energy and carbon

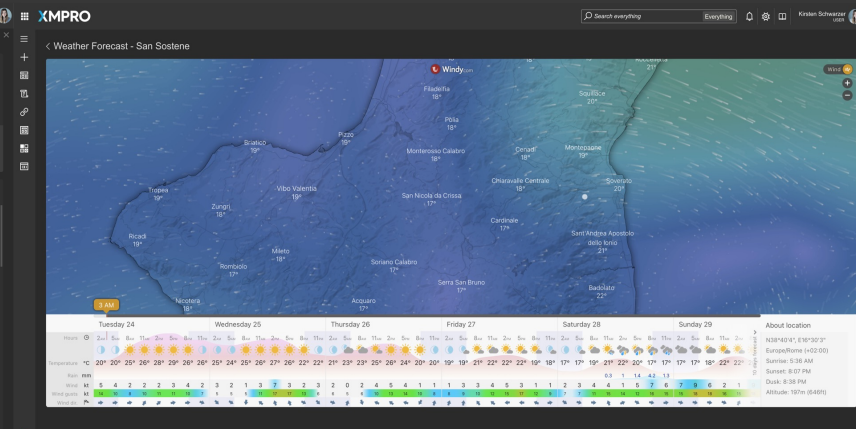
Alternative Energy Portfolio



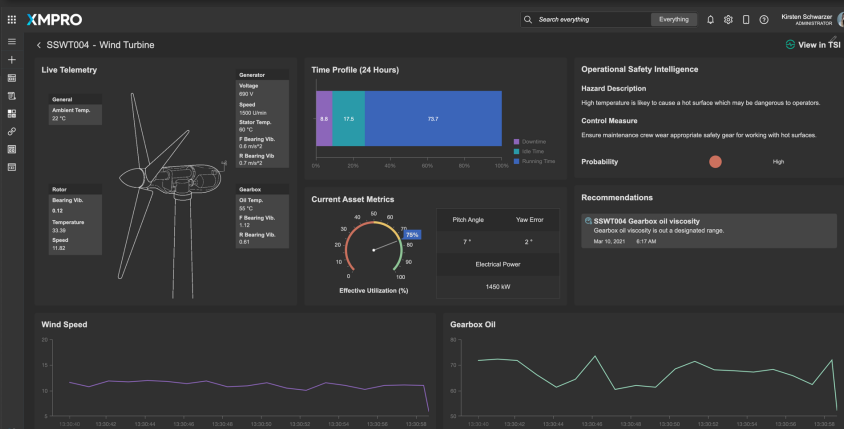
Outcomes Focused



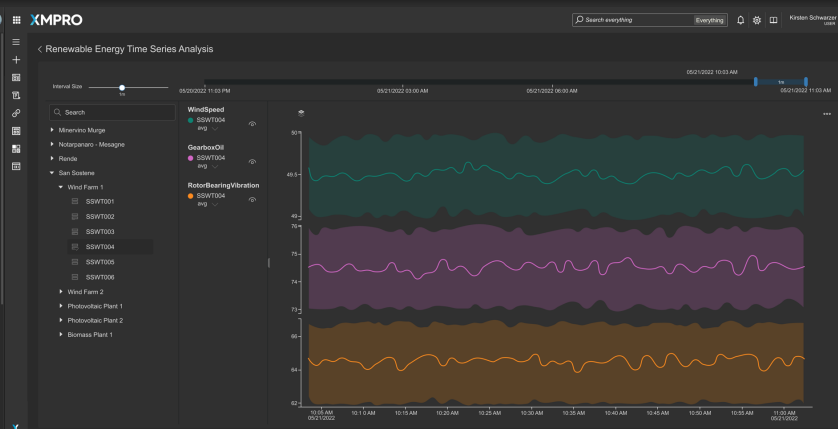
Contextual Meta Data



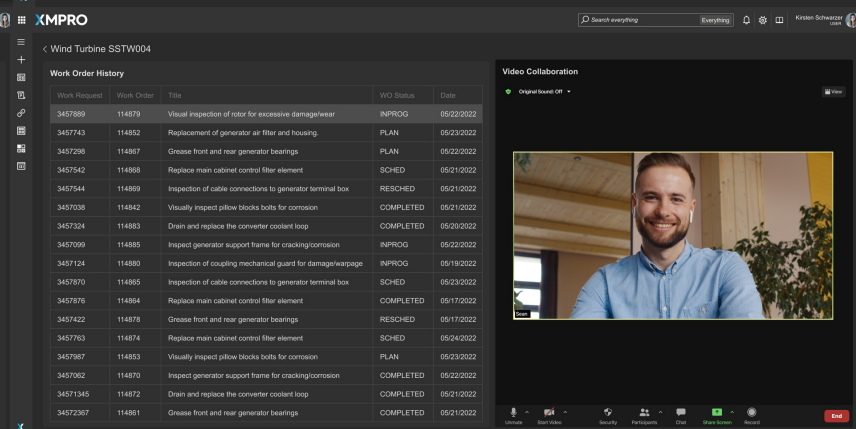
Asset Performance



Advanced Analysis

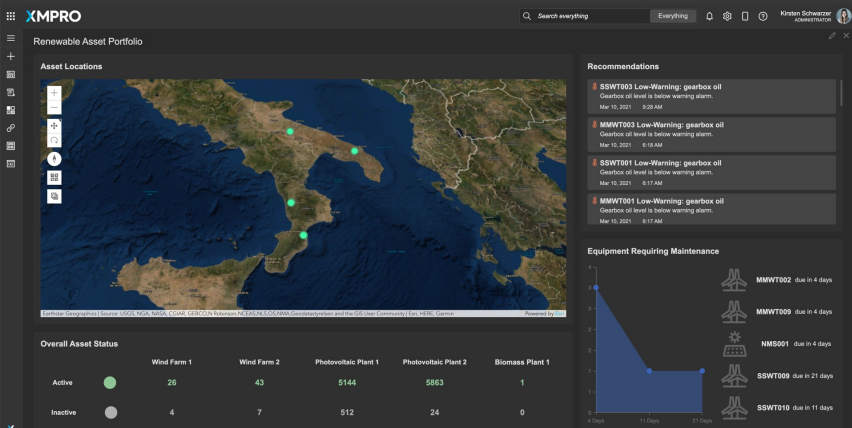


Expert Collaboration

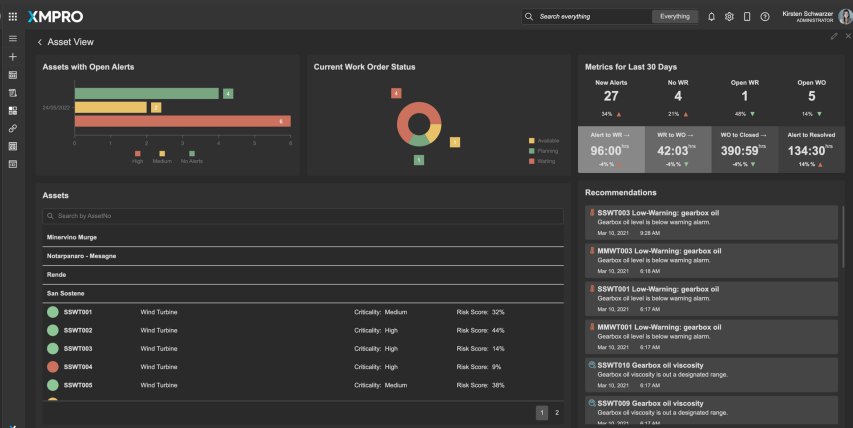


SMEs not in-house

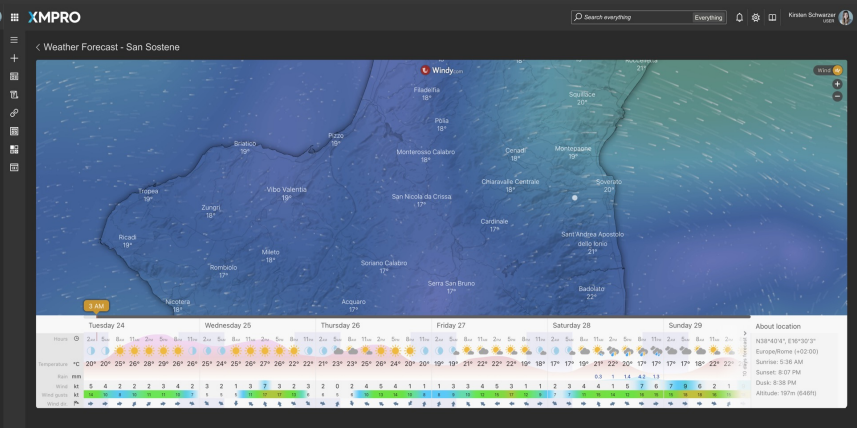
Alternative Energy Portfolio



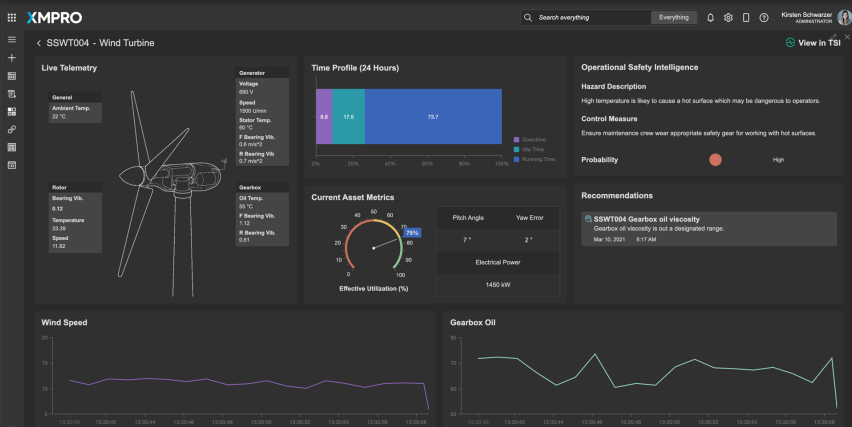
Outcomes Focused



Contextual Meta Data

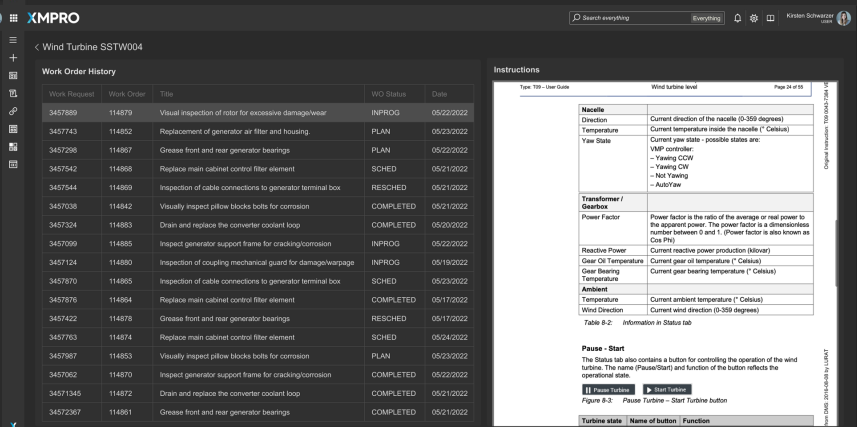


Asset Performance



Advanced Analysis

Access To Knowlegde



Benefits of Digital Twin ROCs for Alternative Energy

Higher earned revenue from improved yield of renewable generation resources

Improvements in operational performance and reduction in losses

Optimization of asset loading needed for the dispatch scheduling changes as renewable energy grows and maximizing generation from renewable assets becomes a high priority

Maximization of asset valuation through the balancing of operational and economic life



THANK YOU